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The Effects of Seductive Details on Recognition Tests and Transfer Tasks

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14. ABSTRACT *(Maximum 200 words)*:

This research focuses on the investigation of pre-training and in-training events that facilitate effective learning and the transfer of knowledge and skills acquired through distributed learning. We tested training effectiveness principles in the context of suboptimal learning. Specifically, we investigated the seductive details phenomenon, a condition in which the inclusion of interesting information irrelevant to the training objectives reduces trainee learning. In terms of our findings, we found no effect of seductive details on recall tests in the experiments. This finding is contrary to much of the previous research that has found that providing seductive details distracts trainees from learning and results in lower scores on recall tests than those who are not exposed to seductive details. However, we did find support for our proposition that inclusion of seductive details benefits transfer performance. These findings suggest that to enhance transfer, distributed learning designers should incorporate interesting yet tangential features into the technology.

15. SUBJECT TERMS
Distributed learning, computer-based training, seductive details, training design

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THE EFFECTS OF SEDUCTIVE DETAILS ON RECOGNITION TESTS AND TRANSFER TASKS

EXECUTIVE SUMMARY

Research Requirement:

This report summarizes research carried out according to the United States Army Research Institute for the Behavioral and Social Sciences' (ARI's) Contract # DASW004K0002, through its Basic Research program. The research focuses on the investigation of pre-training and in-training events that facilitate effective learning and transfer of knowledge and skills acquired through distributed learning, including computer-based training (CBT). The unique contributions of the research were: (1) an examination of design processes that can undermine learning in traditional distributed learning environments, and (2) examination of the effects of training design decisions and principles of training effectiveness to skill-based distributed learning in terms of impact on both learning and transfer. Our approach to studying effective distributed learning expanded previous research in this area. First, rather than focusing on a comparison of training methods, we focused on testing principles of training effectiveness. These were drawn from both the general training literature (e.g., Cannon-Bowers, Salas, Tannenbaum, & Mathieu, 1995; Noe & Colquitt, 2002) and from the CBT literature (e.g., Brown & Ford, 2002). Second, we tested training effectiveness principles in the context of suboptimal learning. Specifically, we investigated the *seductive details* phenomenon, a condition in which the inclusion of interesting information irrelevant to the training objectives reduces trainee learning. The inclusion of seductive details generally harms performance on recall tests, but few investigations have used multimedia training or investigated effects on performance through recall tests or transfer tasks.

Procedure:

We tested our hypotheses through three laboratory experiments. In the first experiment, undergraduates from two universities participated in a computer-based training program on how to use Microsoft Excel. Participants were either exposed to seductive details or not exposed to seductive details. In the second experiment, undergraduates participated in a computer-based training program on how to use Microsoft Mail Merge. This research varied in the types of seductive details that were shown to participants. Some seductive details were totally irrelevant to the material, whereas other seductive details were tangential but not irrelevant. In the third experiment, we replicated an investigation by Harp and Mayer where undergraduates were exposed to either seductive details or not exposed to seductive details.

Findings and Utilization and Dissemination of Findings:

Our findings were mixed. We found no effect of seductive details on recall tests in the two investigations. This finding is contrary to much of the previous research on the seductive detail effect that has found that providing seductive details distracts trainees from learning and

results in lower scores on recall tests than those who are not exposed to seductive details (e.g., Harp & Mayer, 1997; 1998; Mayer, Heiser, & Lonn, 2001). However, in both of the investigations, we found support for our proposition that inclusion of seductive details benefits transfer performance. Our transfer tasks required trainees to perform a task they were trained to do with new stimuli, rather than manipulate learned information to answer problem-solving questions, as done in previous research by Richard Mayer and his colleagues.

In both the military and private sectors, distributed learning is projected to increase in the coming years (Clagg, Detrani, Burnside, & Finley, 1999; Salas & Cannon-Bowers, 2001; Van Buren & Erskine, 2002). For example, the Army plans to convert more than 500 courses to a distance learning format during the next decade (Wisher, Freeman & Morris, 2000). The findings from our research have important implications for how the Army designs computer-based training. Focusing on one cognitive psychology principle, the seductive details effect, we found that seductive details are beneficial for transfer. These findings suggest that to enhance transfer, distributed learning designers should incorporate interesting yet tangential features into the technology.

THE EFFECTS OF SEDUCTIVE DETAILS ON RECOGNITION TESTS AND TRANSFER TASKS

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BACKGROUND

Distributed learning is becoming an increasingly prevalent form of training in modern organizations (Rivera & Paradise, 2006). Distributed learning refers to any form of training in which content is conveyed electronically, including computer-based training, intelligent tutoring systems, and Web-based training. One reason for the growing popularity of distributed learning is that it allows training to occur "just-in-time," even if no trainer is present. Because many distributed learning experiences may occur in isolation, it is important that future distributed learning programs incorporate theoretically-sound, empirically-validated, instructional design principles that optimize learning and transfer of training. In this experiment, we investigated the effects of one training design decision—the inclusion of seductive details to increase learner interest—into a computer-based training program. A seductive detail is "highly interesting and entertaining information that is only tangentially related to the topic but is irrelevant to the author's intended theme" (Harp & Mayer, 1998, p. 1). Seductive details have complex effects on the learning and application of information presented in training.

In recognition of key differences between traditional instructor-led training programs and distributed learning, training experts are beginning to offer new models of effective instruction in computer-mediated environments (e.g., Arbaugh, 2005; Brown & Ford, 2002; Moreno & Mayer, 2002; Oliver, Herrington, & Reeves, 2005; Van Merriënboer, Kirschner, & Kester, 2003). Each model emphasizes the role of the trainee in the learning process, particularly the need for trainees to self-regulate both motivation (interest) and cognition (focus). Self-regulation refers to meta-cognitive, motivational, and behavioral techniques used by learners to control the learning processes (Eom & Reiser, 2000). These strategies include setting goals for knowledge acquisition and maintaining motivation, selecting productive learning strategies, and adjusting strategies in the face of obstacles (Winne, 1995). Self-regulation during learning requires high levels of cognitive engagement (Winne, 1995), but also leads to allocation of greater cognitive resources to learning (Kanfer & Ackerman, 1989), and results in greater learning during training (Eom & Reiser, 2000; Greiner & Karoly, 1976; Kanfer & Ackerman, 1989; Sitzmann, 2006).

While research is emerging on the characteristics and outcomes of self-regulation, less is known about how to help trainees increase attentiveness and involvement during learning. One popular strategy is to make the training content more interesting. Capturing the attention of the learner is perceived as critical for increasing learner interest, which in turn leads to active learning, deeper processing, and better learning and transfer. This relationship is so fundamental that in his classic instructional design model, Gagné referred to capturing the attention of the learner to be the *first event* of instruction (Gagné, 1965; Gagné, Briggs, & Wager, 1988). Dewey (1913) also made the connection between learner interest and learner effort over 90 years ago.

In modern learning theory, learner interest plays a central role in that it influences the selection of specific learning strategies, affects allocation of attentional resources, promotes high task engagement, and results in deeper cognitive processing related to training content (see Hidi, 1990; Schraw, 1998; Wade, Schraw, Buxton, & Hayes, 1993). Izard and Ackerman (2000) suggested that interest serves two important characteristics. First, it motivates exploration and learning, heightening personal engagement in the learning environment. Second, interest acts as an emotional state that sustains active processing or personalization of content. Material that is

interesting is thought to energize the learner, increasing attention to the content, time on task, or effort expended towards encoding information from the training content (Izard & Ackerman, 2000; Kintsch, 1980).

During traditional instructor-led or classroom training, effective instructors may capture learner attention and maintain learner interest through a variety of means including relying on personal charisma (Towler, 2003), using advanced organizers (Mayer, 1979), and telling "war stories" (Joung, Hesketh, & Neal, 2006). Regarding the training content, personal relevance, novelty, activity, and comprehensibility are other embedded factors that serve to raise situational interest in course content. There also is evidence that instructors who involve students in the learning process stimulate engagement and learning (e.g., Guthrie & Anderson, 1999; Pintrich & DeGroot, 1990).

In distributed learning environments, instructional designers cannot rely on the instructor to create interest, so they must generate interest through the creation of interesting learning environments. According to Kintsch (1980), situational or environmentally-based interest may be conceptualized in terms of either cognitive interest or emotional interest. Cognitive interest results when the learner is captured by the ideas inherent in the course material. In contrast, emotional interest may be created by adding interesting material that engages the learner on an affective level (e.g., the learner is emotionally touched by a story contained in the material). Accordingly, instructional designers may elect to augment training content through methods such as interesting text, clip art, graphics and photos, sound and video, or animation in order to engage learners and stimulate their interest in the training material.

The problem of making dry material more interesting faced textbook writers several decades ago. Over time, dry, text-only introductory books were replaced with flashier versions featuring more photos (often of popular cultural figures) and sidebars and supplementary text, many of which were only marginally related to the chapter content, but were thought to be more relevant to young readers (Mayer, Steinhoff, Bower, & Mars, 1995). This effort was rooted in emotional interest theory that suggests that adding interesting, yet irrelevant, information energizes the learner and increases attention because it promotes curiosity in the material even though it might be tangential to the overall learning objectives (Harp & Mayer, 1997). These tangential features were referred to as seductive details. Across investigations in multiple learning formats, seductive details have been operationalized through added text, photos or illustrations, sounds, music, and video (Thalheimer, 2004).

Early research showed that adding seductive details did not have the intended effect on learning; instead the seductive details tended to be detrimental to recall. Garner, Gillingham, and White (1989) found that adding interesting but unimportant sentences to expository texts hindered the learning of the main points of the text. They called this the "seductive details effect." Similar early findings were reported by Wade and Adams (1990) and Garner and Gillingham (1991), who also found that participants remembered the seductive details better than the main text. Many subsequent researchers have reported similar negative effects of seductive details on learning. A common example of a seductive detail in a training context might be a training class that includes humorous cartoons on slides containing tips for effective supervision. Although not necessarily relevant to the topic, the cartoons are designed to make the training

material more interesting, but the results of multiple investigations suggest that their inclusion will harm recall for the primary training content.

Seductive details are perceived as interesting by learners because they may be personally relevant, novel, or graphic. By creating emotional interest, seductive details should have a positive effect on trainee learning. However, they do not aid in the organization of new information, nor necessarily help connect new information to previously learned information—two processes critical in adult learning (Knowles, Holton, & Swanson, 2005). There is evidence that inclusion of seductive details disrupts trainees' focus on the main themes of the material (Harp & Mayer, 1998; Mayer et al., 2001). In one multimedia training study, college students viewed an animation and listened to concurrent narration explaining the formation of lightning (Mayer et al., 2001). In the seductive details conditions, the experimenters added either interesting but irrelevant text details to the narration or added irrelevant video clips within the presentation. Mayer et al. reported that participants in the seductive detail conditions recalled less central information and performed worse on a series of essay questions applying their knowledge to new situations. Harp and Mayer (1998) suggested that seductive details do their damage at the moment learners are consolidating and organizing new information through forming knowledge structures ill-suited for later recall.

In sum, while theory suggests that increasing the interest of training content should aid learning, the seductive detail effect posits that the inclusion of interesting but irrelevant material undermines learning. In a recent meta-analysis, Thalheimer (2004) reviewed nine investigations producing 24 comparisons of baseline training conditions with the addition of some form of seductive details. Across 16 investigations, the inclusion of seductive details had a negative impact on learning (mean $d = -.70$). A negative impact was found for the inclusion of irrelevant text (Harp & Mayer, 1997; Garner et al., 1989; Mayer et al., 2001; Moreno & Mayer, 2002), photos or illustrations (Harp & Mayer, 1997; 1998), and sounds or music (Moreno & Mayer, 2000; 2002). In seven comparisons, there was no noticeable impact of seductive details, and in a final study, the inclusion of seductive details resulted in greater learning (Moreno & Mayer, 2000). In sum, extant research shows that the use of interesting but irrelevant details to raise learner interest is counterproductive. However, only the Mayer et al. (2001) study has employed a distributed learning platform for training. Additional research is needed in this area.

Other changes to the seductive detail research paradigm also are needed. Thalheimer (2004) questioned the relevance of much of the prior research to real-world training situations. Specifically, he noted that the average training session in past investigations was only 3 minutes and the average retention interval was only 4 minutes and 14 seconds. Thus, additional research is needed with longer training sessions. We also note that many prior seductive detail investigations use free recall measures and do not use the more traditional forms of recognition tests used in many classrooms and training programs. Further, no prior research has examined the impact of seductive details on measures of procedural skills (that is, applying skills acquired in training).

It is noted that there are also conceptual issues arising in the seductive detail literature. Proponents of dual-coding theory have challenged the notion that interesting information is distracting to learners (e.g., Sadoski, Goetz, & Rodriguez, 2000). There is evidence that

interesting and engaging information promotes image-based thoughts and is better remembered because it allows for storage of material in both verbal and nonverbal systems (Paivio, 1986; Sadoski et al., 2000; Sadoski, Goetz & Fritz, 1993). This suggests that interesting material, even if tangential to the topic, does not detract from learning and can promote recall of vague or uninteresting material (Sadoski & Paivio, 2001; Paivio, 1986; Mayer & Anderson, 1991).

Accordingly, there is a need for more research on the effects of interesting, tangential material in distributed learning environments. Classic learning theories and modern dual-coding theory support the introduction of interesting, tangential details, but prior research on seductive details suggest that such a strategy may in fact be detrimental to learning. With the exception of one study (Mayer et al., 2001) no prior studies have examined the effect of seductive details in distributed learning environments, despite the increasing popularity of such learning environments and the temptation to build learner interest by augmenting training content (in the absence of a live instructor). Moreover, no studies to date have examined the impact of seductive details on skills learning. It seems important to consider the influence of seductive details on skills learning, because skills acquisition is an integral component of learning outcomes in distributed learning (Brown & Ford, 2002).

The two investigations below address these shortcomings and thus make a substantive contribution to research on seductive details and our knowledge of effective distributed learning environments. We present and support our hypotheses below. These hypotheses were tested in a laboratory setting involving two distributed learning programs designed to train advanced skills in Microsoft Excel and Microsoft Mail Merge. Below we distinguish between anticipated effects of seductive details on measures of knowledge acquisition and transfer of training.

Knowledge Acquisition

Early research focused primarily on seductive details in text comprehension (Garner, 1992; Hidi, 1990; Garner et al., 1989; Harp & Mayer, 1998; Mayer, Bove, Bryman, Mars, & Tapangco, 1996). This early research suggested that inclusion of seductive details, including tangential illustrations and text, reduced students' retention of material (Garner, 1992; Hidi, 1990; Harp & Mayer, 1998). Typically, individuals tended to remember interesting adjuncts included in a passage of supplementary text rather than structurally important ideas (Garner, Alexander, Gillingham, Kulikowich & Brown, 1991; Hidi & Anderson, 1992). In the presence of seductive details, individuals tended to recall less information, regardless of whether the important ideas were interesting or not interesting (Schraw, 1998).

In this effort, we focused on the effect of seductive details within the context of an aural presentation: Only two studies have employed this context (Mayer et al., 2001; Moreno & Mayer, 2000). In the research most relevant to ours, college students viewed a multimedia animation and listened to concurrent narration explaining the formation of lightning (Mayer et al., 2001). To obtain the seductive detail effect, the experimenters added either interesting but irrelevant details to the narration or irrelevant video clips within the presentation. Overall, they found that participants in the seductive details condition recalled less information about lightning formation. Based on this previous research, we propose the following hypothesis:

H1: Participants in the non-seductive details condition will perform better on a declarative knowledge test than those in the seductive details condition.

Transfer of Training

The seductive details phenomenon has been replicated in a number of settings (e.g., CBT, classroom training, and programmed instruction) in several different content areas. However, the effect has been primarily demonstrated at the point of knowledge acquisition (initial learning); its impact on transfer performance has not been clearly shown. The relationship between learning and transfer is complex and it is risky to assume that decrements in knowledge acquisition necessarily hinder transfer. For example, in some contexts, impeding initial learning (i.e., acquisition), may improve later transfer (Holladay & Quiñones, 2003; Schmidt & Bjork, 1992).

Theory in text comprehension (Van Dijk & Kintsch, 1983) suggests that seductive details might be deleterious for recall but advantageous for transfer performance because of the schematic representation of information that trainees form during instruction. A minimum level of text comprehension exists when the reader has a schema or mental representation of the macrostructure of a text. For instructional material, this would entail the learner knowing the main topic of a passage, knowing the major subtopics, and the relationships between the topic and subtopics. Researchers have described the seductive details effect as having deleterious effects on recall because it distracts trainees from learning (e.g., Garner et al., 1989) and because trainees tend to form inappropriate schemas to organize information (Harp & Mayer, 1998). Empirical studies suggest that distortion of the macrostructure or schema of the instructional material is detrimental when learners are attempting to recall material but is beneficial when learners are applying knowledge (Mannes & Kintsch, 1987; McNamara, Kintsch, Songer & Kintsch, 1996). For example, McNamara et al. (1996) found that students who read an organized text performed better on recall tasks than those who read less organized text. However, students who read less organized material performed better on tasks that required an application of knowledge to problem solving than those given the organized material.

Given that seductive details do their damage through distorting the schema of instructional material, this suggests that inclusion of seductive details might be beneficial for transfer performance but detrimental when trainees are recalling information. Kintsch (1994) suggested that when instructional material fits well into preexisting schema, there is little inducement for elaborating a complex situation model. Interference from seductive details creates confusion of what was in the core material, so that recall will not be as good and more errors will occur. However, this distortion can lead to a richer understanding of the material and facilitate transfer performance because trainees are required to form a macrostructure of instructional material. Research using the dual-coding paradigm also suggests that interesting and engaging information promotes image-based thoughts and leads to deeper processing of information because it allows for storage of material in both verbal and nonverbal systems (Paivio, 1986; Sadoski et al., 2000; Sadoski et al., 1993). Craik and Tulving's (1975) depth of processing theory suggests that when information is made easier to comprehend, material is processed less deeply, thus leading to poorer acquisition of information. The seductive details effect has been robust in suggesting that seductive details have a negative effect on trainees'

recall. However, based on Kintsch's research and theory from the dual-coding paradigm, we hypothesize that seductive details have a beneficial effect for transfer performance.

H2: Participants in the seductive details condition will perform better on transfer than those in the non-seductive details condition.

To test these hypotheses, we conducted two investigations to examine the effect of seductive details on recall and transfer performance. In both experiments we looked at the effect of seductive details within distributed learning across two learning domains—Microsoft Excel and Microsoft Mail Merge. We proposed that seductive details would have positive effects on transfer performance and negative effects on the recognition of declarative knowledge.

EXPERIMENT 1

Method

Participants and Design

Forty-six undergraduates and one graduate student at a Midwestern university participated in the current experiment (N = 47). Participants were recruited from psychology classes with the offer of obtaining extra credit and free training in Microsoft Excel. The average age of participants was 20.6 years and 40% of participants were women. The participants were randomly assigned to one of two groups: (1) no aural seductive details (N = 24), and (2) aural seductive details (N = 23).[1]

Training. The training provided instruction to participants on Microsoft Excel, a popular software package that allows individuals to create and edit spreadsheets. The instruction was passive in that participants listened to a narration and viewed the screen. There was no practice of skills during the training. The training session was an audio-visual file heard through headphones and viewed on a 17-inch computer monitor. The file contained animated videos with screen shots in Excel of each step in the training. The participant would see the cursor move to the appropriate menus and see the drop-down options. The training lasted approximately 15 minutes and displayed various examples of spreadsheet features. The features included formula usage, range manipulation, using the chart wizard, conditional formatting, and data filtering. The context of the training was a data-driven methodology to select a city to inhabit based on the average temperature and rainfall of cities around the world. The training included audio explaining the various Excel skills demonstrated in the video.

Procedure and manipulations. Participants were randomly assigned to either a seductive details or no seductive details condition. Seductive details were instructionally irrelevant material related to the city or weather data presented in training, such as, "Askmen.com recently listed the top 10 cities for beautiful women. The top five are all listed in this worksheet: Prague,

[1] Following Mayer et al. (2001), the study was actually run with the seductive details condition crossed with the presence or absence of supplementary text. However, there was no main effect for text, and for clarity of presentation we collapsed supplementary text conditions to produce a single factor design.

Copenhagen, Caracas, Milan, and Rio de Janeiro. Rio de Janeiro also got high marks as a destination site for its abundant beaches and never-ending nightlife. Tulsa did not make the top 10." Text-summaries were text presented simultaneously with verbal explanations of training concepts, such as the text, "Estimate Celsius temperature by subtracting 30 and dividing by 2."

Participants completed measures of their familiarity with Excel and demographics prior to training and proceeded to watch the audio-visual course. Immediately after training, the participants completed a declarative knowledge test. Immediately following this task, participants completed two transfer tasks, applying the skills covered in training (e.g., entering formulas and creating charts) to two unique data sets. The participants were given 15 minutes to complete the recognition test and were given up to 1 hour to complete the transfer tasks.

Measures

Previous application use. Use of Excel prior to training was assessed using a single item, "How frequently do you use Excel?" Participants chose one of five response options ranging from "Never" to "4 or more times per week." In earlier pilot work, we used a 10-item multiple-choice test to assess prior knowledge of Excel. Responses to this single item correlated highly with summed scores on the 10-item test and correlated highly with transfer task scores. Accordingly, we used the single-item measure to assess prior Excel experience in this experiment.

Declarative knowledge. Declarative knowledge was measured with 12 multiple-choice questions assessing participants' retention of factual information taught during training. An example is "Mathematical calculations can be made in Excel using: a) formulas b) calculators c) models d) objects" with participants choosing one of the four response options. Participants obtained one point for each correct response with scores ranging from 0 to 12. We did not compute coefficient alphas for the recognition test because the questions assessed different aspects of knowledge concerning Microsoft Excel. Other researchers have adopted this practice when the questions tap into distinct, yet interdependent, sections of knowledge (e.g., Gully, Payne, Koles, & Whiteman, 2002).

Transfer performance tasks. Transfer of procedural knowledge was assessed with two transfer tasks. Both tasks required trainees to perform the skills taught in training, including calculating an average based on a range of values, conditionally formatting a range, creating a chart, and filtering data. For each sub-task within an overall transfer task, a point was given for the correct procedure. Each transfer task was evaluated by two judges trained with a mutually agreed-upon scoring method and previously agreed-upon answers. Anytime there was disagreement between judges, the judges were required to discuss their scores until consensus was reached. We averaged the scores for the two transfer tasks to measure overall transfer performance.

Results

Table 1 presents descriptive statistics and correlations for the variables. The mean level of knowledge of Excel before training was 2.17 (SD = 1.13), indicating that trainees on average

used Excel between one and three times per semester. The presence of seductive details was significantly correlated with transfer performance such that trainees in the seductive details condition performed at a higher level on the exam than trainees who did not receive seductive details ($r = .34, p < .05$). Trainees who used Excel before training performed at a higher level on the declarative knowledge exam than trainees who had not previously used Excel ($r = .37, p < .05$), and scores on the declarative knowledge test and transfer performance tasks were positively correlated ($r = .60, p < .05$).

Table 1
Descriptive Statistics and Correlations for Variables in Experiment 1

		Mean	SD	1	2	3	4
1	Use of Excel	2.17	1.13				
2	Seductive details	0.49	0.51	0.08			
3	Declarative knowledge	9.17	1.75	0.37*	0.20		
4	First transfer task	0.73	0.22	0.28	0.34*	0.61*	
5	Second transfer task	0.73	0.20	0.17	0.31*	0.54*	0.86*

Note. * $p \leq .05$. The seductive details condition was dummy coded: 0 = no, 1 = yes.

Hypothesis Testing

Two analyses of covariance (ANCOVA) were run to assess the effect of seductive details on learning outcomes while controlling for previous use of Excel. Previous use of Excel had a significant effect on declarative knowledge ($F(1, 42) = 23.37, p < .05, \eta^2 = .18$), but did not have an effect on transfer performance ($F(1, 42) = 2.13, p > .05, \eta^2 = .05$). Trainees who were familiar with Excel before training learned more declarative knowledge than trainees who were not familiar with Excel. The seductive detail condition did not have a significant main effect on recognition for declarative knowledge ($F(1, 42) = .38, p > .05$), failing to support the first hypothesis. Note however that contrary to most past research, participants receiving seductive details scored slightly higher than participants who received no seductive details ($r = .20, p > .05$). Consistent with the second hypothesis, seductive details had a significant main effect on transfer performance ($F(1, 42) = 4.99, p < .05, \eta^2 = .11$). Trainees who received seductive details performed at a higher level (M = .79) on the transfer tasks than trainees who did not receive seductive details (M = .67), supporting hypothesis two.

Discussion of Experiment 1

Prior research has repeatedly found that the introduction of seductive details has a detrimental effect on recall of the primary training content. However, there have been relatively few investigations of the effects of seductive details on skill-based learning in distributed learning environments, examining both knowledge acquisition and effects on transfer. Unlike most previous seductive detail investigations and contrary to our first hypothesis, participants in the seductive detail condition did not perform worse on a multiple choice test of declarative knowledge than did participants in the no seductive detail condition. Most prior investigations used shorter training programs, tested participants' recall of training material (rather than

recognition of the correct answer), and tested knowledge of external systems rather than personal skills. Any of these differences could have accounted for differences between our research and prior investigations.

We did find support for our second hypothesis: participants in the seductive detail condition performed better on a transfer task than did participants in the no seductive detail condition. This finding is consistent with several theoretical positions that state that learning conditions that disrupt the rehearsal or organization of new information has a positive effect on later transfer (Holladay & Quiñones, 2003; McNamara et al., 1996; Schmidt & Bjork, 1992; Van Dijk & Kintsch, 1983). One issue with the method is that participants completed the recognition tests following training, but they completed the transfer tasks immediately following the recognition tests. Their performance on the recognition tests might have influenced their performance on the transfer tasks, so we can not be certain that the results we obtained were purely due to the inclusion or exclusion of seductive details. Additional research is necessary to understand properties of seductive details that influence the acquisition and application of new information.

EXPERIMENT 2

The second experiment was a replication and extension of the first experiment. First, we wished to replicate the findings from Experiment 1 in a different setting using another training program (Microsoft Mail Merge). We extended the second experiment through testing the effects of different types of seductive details on recognition and transfer performance. Seductive details can vary in terms of the extent to which the interesting information is tangential to the main body of knowledge (Schraw, 1998). So, to better understand the seductive details effect, we tested whether seductive details had a deleterious effect depending on whether they were dependent on or independent of instructional content. For example, in the context of providing instruction on the use of Microsoft Mail Merge, an example of dependent seductive detail is "The Windows NT software was developed by Microsoft-Israel," whereas an independent seductive detail is "Top graduate schools often accept up to only 10 applicants per year." As can be seen in the examples, dependent seductive details are tangentially related to the instructional material, whereas independent seductive details have no relevance to the instructional material.

This second experiment examines the assumption that seductive details represent a heterogeneous class of information and that learners will devote more processing time to context-dependent seductive details than to context-independent seductive details (Schraw, 1998). Little research has examined differences in type of seductive details on recognition or transfer. In a series of studies, Schraw (1998) found no difference between context-dependent seductive details, context-independent seductive details, and no seductive details on recall of stories about Horatio Nelson. Given these findings, Schraw argued that there was no evidence that seductive details had a negative influence on recall. He did not test the effect of seductive details on transfer, and Schraw's study involved text comprehension rather than skills-based training. Schraw (1998) did find that participants devoted more processing time to reading context-dependent seductive details, but this processing time was not related to overall recall of material. Earlier, we speculated that seductive details may improve transfer performance through increased depth of processing. Consequently, we might find longer processing time for context-

dependent seductive details resulting in better transfer performance. However, no prior studies have examined the effects of different types of seductive details on recognition or transfer. Consequently, given the paucity of research in this area, we tested the effects of context-dependent and context-independent seductive details on recognition and transfer without proposing directional hypotheses. Similar to Experiment 1, we predicted main effects for seductive details on learning, with the presence of seductive details being detrimental to the acquisition of declarative knowledge, but facilitative to transfer performance.

Method

Participants

Seventy-seven undergraduate students from a Midwestern university participated in the experiment. Participants were recruited from psychology classes with the offer of obtaining extra credit. Forty-eight participants were male and 29 were female.

Design

The participants were randomly assigned to one of three groups: (1) no seductive details ($\underline{n}$ = 24), (2) independent seductive details ($\underline{n}$ = 28), or (3) dependent seductive details ($\underline{n}$ = 25).

Training. The training provided instruction to participants on Microsoft Mail Merge, a function of the popular software package Microsoft Word that allows individuals to create customized form letters. It also can be used in conjunction with Microsoft Excel, which is used as a database for information such as addresses. The training session was an audio-visual file that participants listened to with headphones and viewed on a 17-inch computer monitor. The file contained animated videos with screen shots of Microsoft Word's Mail Merge and Excel programs. Participants saw the cursor move to the appropriate menus and viewed the drop-down options. The overall topic of the training was how to use Mail Merge to organize and send personalized letters in mass mailings. The training was broken into modules: The participants first learned the purpose of Mail Merge and how to manage a database of information, then they learned how to filter and sort the information, and lastly they were taught how to conditionally format information.

Procedure and manipulations. Participants were randomly assigned to one of the aforementioned conditions. Those in the independent seductive details condition listened to interesting pieces of information that were independent of the training material. This independent seductive details provided information about graduate schools and careers and included information such as: "Eighty percent of today's top 50 fastest growing occupations will require that you get some education after high school," "Top graduate schools often accept up to only 10 applicants per year," and "Some undergraduate institutions have concurrent Bachelor's and Master's degrees so students obtain them within five years."

Those in the dependent seductive details condition listened to interesting pieces of information that were directly related to the training content, yet were irrelevant to the learning objectives. All of the dependent details contained information concerning Microsoft or Microsoft

Mail Merge but were not directly related to the learning material. In this way, they were tangential but at least superficially relevant. Examples included: "Mail Merge can be used to create numbered raffle tickets, receipts, or coupons," "The Windows NT software was developed by Microsoft-Israel," and "Mail Merge also allows you to attach postal bar codes to your address labels, which can save you money if you send large batches of mail."

The following procedures were used to create the seductive details used in this experiment. First, seductive details were generated by four of the authors who came to agreement on whether the seductive details were independent or dependent of the training material. Then, the same four authors and two undergraduate students (who were unfamiliar with the experimental hypotheses) rated each of the seductive details segments on the extent to which they were interesting, using a scale of 1 (not at all interesting) to 7 (very interesting). Only those items receiving an average score of 5 or higher on the interest scale were used as seductive details. The average rating on the interesting item for both the independent and dependent seductive details was $M = 5.36$.

Participants completed measures of their familiarity with Excel and demographics prior to training and then watched the audio-visual course. Immediately after training, participants completed a declarative knowledge test. Immediately following this task, participants completed one transfer task, applying the skills covered in training (e.g., filtering information). The participants were given 15 minutes to complete the recognition test and up to 1 hour to complete the transfer tasks.

Measures

Previous application use. Use of Mail Merge prior to training was assessed using 2 items. The first item read "How frequently do you use Microsoft Mail Merge?" Participants chose one of five response options ranging from "Never" to "4 or more times per week." The second item was "Compared to other functions in Microsoft Word, how familiar are you with Microsoft Mail Merge?" Participants chose one of five response options ranging from "Much less familiar" to "Much more familiar." The two items were combined to form an average score of previous application use ($\alpha = .72$).

Declarative knowledge. Declarative knowledge was measured by a 13-item multiple choice learning outcome measure designed specifically for this experiment. Items included:

"What is the purpose of Mail Merge?"
a) To send the same letter out to multiple recipients
b) To produce mailing labels
c) To make envelopes for mass mailing
d) All of the above

Participants chose one of the four response options for each item. Participants obtained one point for each correct response with scores ranging from 0 to 13. As in Experiment 1, we did not compute coefficient alphas for the recognition test because the questions assessed different aspects of knowledge concerning Microsoft Mail Merge.

Transfer performance. Transfer performance was measured following completion of the declarative knowledge test. The participants were asked to perform the skills that had been taught in the training session. The participants were given a short scenario regarding the purpose of the task. The scenario asked the participant to pretend to look for a job and to send out cover letters and resumes to potential employers from a database of employers. Based on the scenario, the participant had to utilize the skills taught in the training in order to answer five distinct questions. These questions required the participants to complete tasks including conditional formatting and filtering for certain criteria (e.g., addresses, cities, etc.). For example, one questions asked participants "How many letters were being sent to individuals in Chicago?" This question required knowledge of filtering for certain criteria. For each sub-task within an overall transfer task, a point was given for the correct procedure. Each transfer task was evaluated by two judges trained with a mutually agreed upon scoring method and previously agreed-upon answers. Anytime there was disagreement between judges, the judges were required to discuss their scores until consensus was reached.

Each participant had up to 1 hour to complete both transfer tasks. Experimenters recorded how long it took each participant to complete the transfer tasks. Actual completion time ranged from 8 to 42 minutes. Since some participants could eventually complete the transfer tasks through trial-and-error without applying the training, we controlled for task time in subsequent analyses.

Results

Table 2 presents descriptive statistics and correlations for the variables. On a scale of 1 to 5, the mean level of perceived knowledge of Mail Merge before training was 1.14 (SD = .62). This indicated that participants were unfamiliar with the program and rarely used it. Of interest, declarative knowledge scores also were related to transfer performance (r = .43, p < .05). Transfer task time was significantly negatively correlated to declarative knowledge (r = -.47, p < .05) and transfer task scores (r = -.47, p < .05).

Table 2
Descriptive Statistics and Correlations for Variables in Experiment 2

		Mean	SD	1	2	3	4	5
1	Use of Mail Merge	1.14	0.62					
2	Declarative knowledge	10.14	1.63	0.11				
3	Transfer task	13.68	5.39	0.08	0.43**			
4	Transfer task time	18.22	7.77	-0.01	-0.47**	-0.47**		
5	Independent SD condition	-	-	0.10	0.05	0.26*	0.04	
6	Dependent SD condition	-	-	-0.04	-0.06	-0.09	0.03	-0.52**

Note. * $p \leq .05$; ** $p \leq .01$.

Two ANCOVAs were run on declarative knowledge and transfer performance scores, controlling for transfer task time and previous experience. Consistent with Experiment 1, there was no effect of seductive details on declarative knowledge; mean scores on the declarative

knowledge test were similar across the three conditions. Also, consistent with Experiment 1, there was a significant main effect for seductive detail condition on transfer performance (F (2, 62) = 4.19, $p < .05$, $\eta^2 = .12$). Of interest, though, was the pattern of mean scores across the two seductive detail conditions and the control group. We conducted post-hoc tests rather than planned comparisons because we did not have directional hypotheses. Transfer task scores were higher for participants exposed to independent seductive details ($M = 15.62$, $SD = 1.03$) than for participants in the control group ($M = 11.15$, $SD = 1.17$). There was no difference between the dependent seductive details ($M = 13.03$, $SD = 1.07$) and the other groups.

Discussion of Experiment 2

As in Experiment 1, there was no main effect for seductive detail condition on declarative knowledge test scores. However, there was a main effect for seductive details (at least for independent seductive details) on transfer performance. Transfer performance was better in groups that were exposed to independent seductive details than for the control group. There was no difference between the dependent seductive details condition and other conditions. Consistent with Experiment 1 (and contrary to the findings of many previous studies), the introduction of (independent) seductive details had a facilitative effect on transfer performance.

EXPERIMENT 3

Since the first two experiments failed to replicate earlier findings by Mayer and colleagues (e.g., Harp & Mayer, 1997; 1998; Mayer et al., 2001), we attempted to conduct a tight replication of one of these earlier investigations. Due to careful documentation in Harp and Mayer (1998), we were able to replicate exactly the design and instructions of that earlier design. Participants read the exact same materials (by condition) as did the participants in Harp and Mayer, although (in hindsight), there was one small difference in the layout of stimuli between investigations (addressed below). We hypothesized, as found by Harp and Mayer (1998), that the inclusion of seductive details would have a negative effect both on recognition and problem-solving task performance.

Method

Participants

Sixty-two undergraduates at a Southwestern university participated in this research for extra credit.

Design

Following the design in Harp and Mayer (1998), participants were assigned to one of four conditions: (1) a baseline condition, (2) baseline plus seductive details, (3) baseline plus seductive illustrations, and (4) baseline plus seductive illustrations and seductive text.

Procedure

In all conditions, participants read a scientific explanation of how lightning forms. Seductive details were in the form of interesting information about lightning but irrelevant to its formation (e.g., the number of Americans per year struck by lightning) and/or interesting pictures irrelevant to lightning formation (e.g., a high school football player whose uniform had been burned by lightning). All text and seductive details were identical to those used by Harp and Mayer. Participants completed the training material and answered four open-ended questions applying what they had learned. Participant responses were scored by two researchers and summed across questions. Note that these transfer questions are actually problem-solving or applied questions rather than performance-based measures as used in Experiments 1 and 2.

Results and Discussion of Experiment 3

Two one-way ANOVA revealed significant main effects for seductive details on the recognition test and scores across the four "transfer" or problem-solving questions. Post hoc comparisons of recognition measures indicated that participants performed best in the base (no seductive detail) condition, and worst in the base + text + illustration condition. Post hoc comparisons revealed that problem-solving scores were lowest in the base + text + illustration condition, but there were no differences between the other three conditions. In general, these results are similar to those obtained by Harp and Mayer (1998), although not as strong for the seductive detail text and seductive detail illustration conditions.

Thus, the replication suggests that prior results may not be lab specific, and that differences in effects for seductive details from investigation to investigation may be due to subtle interactions between learning materials and participants' capacity to learn and/or differentiate between relevant and irrelevant materials. For example, in a phone discussion with Mayer after this experiment was conducted, we learned that our participants read one page of material (with or without seductive details) at a time, whereas Harp and Mayer subjects read two pages at a time, like an open book. Presumably, in their study, by having to retain two pages of information at once, subjects had greater cognitive load at the point of learning (than participants in our experiment who read one page), making them more susceptible to the inclusion of extraneous details. Cognitive load is increased, possibly, because participants are visually absorbing material from two pages rather than one. Cognitive load theory suggests that learners can absorb a limited amount of material into working memory and if they are overloaded with information then they fail to form knowledge schemas that can be transmitted to long-term memory banks (Sweller, 1988).

Interestingly, Harp and Mayer (1998) also concluded that "seductive details do their damage" by interfering with the organization of information at the point of learning. However, visual inspection of the free recognition measures in the three seductive details conditions shows strong organization of information. Even though upon presentation the seductive details were interspersed with the primary information, participants frequently presented the seductive details (organized) together at either the beginning or end of their recall statements.

GENERAL DISCUSSION

In these investigations, we addressed strategies for enhancing trainees' level of interest within a skills-based training environment. Specifically, we examined the seductive details effect and its influence on the acquisition of declarative knowledge and transfer of knowledge to skilled performance. Based on previous research findings, we hypothesized that seductive details would have a deleterious effect on declarative knowledge but a beneficial effect on transfer performance.

Interpretation of Results: Effects on Knowledge Acquisition

In terms of our findings, we found no effect of seductive details on recognition tests in the two investigations. This finding is contrary to much of the previous research on the seductive detail effect that has found that providing seductive details distracts trainees from learning and results in lower scores on recall tests than for those who are not exposed to seductive details (e.g., Harp & Mayer, 1997; 1998; Mayer et al., 2001).

There are several possible explanations for differences in our findings and most prior investigations. Most previous research has focused on learning about complex systems (e.g., how lightning forms), while our efforts focused on learning procedural skills in software programs. Seductive details that disrupt the organization and assimilation of new knowledge about external systems (see Harp & Mayer, 1998) may not have the same effect when learning a set of procedural skills one intends to use. Another reason for the differences in findings is that Mayer and his colleagues have typically used recall, as opposed to recognition, tests. For example, Harp and Mayer (1997) tested participants on their knowledge of how lightning is formed. Once participants had read the instructional material, they were asked to recall as much as they could remember. In our investigations, participants were asked to choose the correct answer from a set of answers—tests of recognition. Cognitive psychologists have suggested differences in memory processing for recall vs. recognition tests. Some cognitive models suggest that whereas recall involves relatively slower memory processes and requires more encoding of information, recognition is faster because the information is familiar (Atkinson & Juola, 1974; Yonelinas, 2002; Donaldson, 1996). It is possible that seductive details do not have detrimental effects when trainees are performing recognition tests because information processing is fast enough to sideline tangential schemas. Alternatively, it may be that seductive details do their damage not at the point of organizing and storing information, but at that point of remembering it. Recognition testing may allow participants to demonstrate learning in a way that recall testing cannot.

Alternatively, there may be differences in the type or potency of seductive details in our investigations compared to prior ones. Beyond the aforementioned research on dependent vs. independent seductive details, there is little guidance on writing "good" seductive details. Much of the work by Mayer and associates used graphic seductive details, for example, a description of a football player struck by lightning. Ours tended to be less graphic and more related to either the content of the training or characteristics of the software. More research is needed on how properties of seductive details affect their impact on the organization and recall of knowledge.

Finally, recent work on cognitive load theory (Kalyuga, Chandler, & Sweller, 1999; Van Merriënboer & Sweller, 2005) suggests that learners' capacity to learn is a function of their cognitive resources, content difficulty, and training design features (which could include the use of seductive details). Thus, it is possible that total cognitive load differed between our paradigm and previous paradigms (e.g., through a slower pace for training), reducing the potential impact of seductive details in our research. Regardless of the explanation for these differences, our results suggest the need for caution in promoting the generalizability of the seductive detail effect, as well as the need for more research on boundary conditions for the effect.

Interpretation of Results: Effects on Transfer Performance

In Experiments 1 and 2, we found support for our proposition that inclusion of seductive details benefits transfer performance. In previous research conducted by Mayer and his colleagues, transfer has been operationalized as a series of essay-style questions, such as "What could you do to decrease the intensity of lightning?" or "What causes lightning?" These types of questions are actually problem-solving questions in that they require directed thinking and use of skills manipulating a learner's knowledge (Gilhooly, 1982). However, these tests are different from our tests in that they do not require the learner to apply their knowledge in a skills-based setting. Our transfer tasks required trainees to perform a task they were trained to do using new stimuli, rather than manipulate learned information to answer problem-solving questions. These differences in transfer tests between our investigations and Mayer's might account for the differences in results. There is evidence from multiple research disciplines, such as reading comprehension (Van Dijk & Kintsch, 1983), experimental psychology (Schmidt & Bjork, 1992), and training (Holladay & Quiñones, 2003), that making initial learning more effortful (e.g., by forcing learners to separate relevant from irrelevant information) results in broader and/or deeper representations of knowledge, that in turn facilitate applying that knowledge to novel situations. Thus, it may be that providing seductive details is detrimental if learners are asked to do problem-solving using new information, but beneficial if they are expected to apply their skills in new situations.

Implications

These findings have implications for training and development theory and instructional practice. Several researchers (e.g., Robinson & Robinson, 1995) suggest that less than 30% of what people learn during training is transferred to the workplace. Consequently, researchers have focused on transfer because it is important that trainees apply the knowledge and skills they have learned during training to their actual jobs. These findings suggest that to enhance transfer, distributed learning designers should incorporate interesting yet tangential features into the technology. These findings tend to support the notion that individuals demonstrate better application of knowledge when they are encouraged to process material deeply (e.g., Craik & Tulving, 1975) and when they actively form flexible schemas, which are generalizable across domains. The use of seductive details allows trainees to actively process information so they are able to produce schematic representations of information and then apply this within a problem-based setting (e.g., Spiro, Vispoel, Schmitz, Samarapungavan, & Boerger, 1987). The research also suggests that distributed learning designers need to incorporate features that engage the learner and enable active processing of information.

In the second experiment, we found that independent seductive details were more beneficial for transfer than no seductive details, but that there was no difference between the dependent seductive details and the other conditions. Previous research has not examined how heterogeneous groups of seductive details influence declarative knowledge and transfer performance. Schraw (1998) found that participants devoted more processing time to reading dependent seductive details, but this processing time was not related to overall recognition of material. However, it is possible that independent seductive details might be most effective for transfer, because learners do not devote more processing time to them and so are not as distracted. Paying too much attention to seductive details might result in cognitive overload, leading to deficits in performance.

This finding has practical implications for trainers and instructional designers because it suggests that when conveying instructional material, it might be beneficial to incorporate snippets of information that are not related to the material. For example, showing cartoons or telling jokes mid-way through a lecture might get trainees to refocus on what they have learned so far. In some ways, the independent seductive details might serve as an intermission or training break. Training research has demonstrated that spaced practice, where trainees have rest intervals within practice sessions rather than massed practice, is most beneficial to trainee learning. In fact, spaced practice appears particularly beneficial for skills training (DeCecco, 1968).

Limitations and Future Research

There are limitations to this research. First, our use of undergraduate students increases the relevance of the research to classroom instruction, but limits the generalizability of our findings to workplace training. However, students probably learn in a similar fashion to employees, so the use of students in this context is appropriate (Campbell, 1986). The second limitation is that we did not test people across different periods of time. Typically, several days have elapsed before trainees are able to apply their knowledge in a different setting. Consequently, future research should focus on testing these effects across different samples, different time periods, and different settings.

Another area for future research is to consider why seductive details have a positive influence on transfer of procedural knowledge. In our introduction, we suggested that seductive details are beneficial for transfer because trainees are forced to create their own schema of the instructional material. Seductive details probably have a beneficial influence on trainees' affect and motivation. Future research could focus on whether seductive details have a positive influence on trainees' transfer performance through increasing arousal. Several researchers have argued that emotion-laden material is most beneficial for tasks that require application of knowledge (e.g., Humphreys & Revelle, 1984). The Brown and Ford (2002) model suggests that when learners are highly motivated and mindful they are more likely to be active participants in training. Future research might include possible mediators such as state goal orientation to determine whether seductive details are beneficial because they encourage trainees to increase their competence in a given domain (Dweck, 1986). Finally, more research is needed to understand what properties of seductive details make them more or less potent, and how

seductive details combine with course material and other aspects of the human/computer interface to create excessive cognitive load in learners.

Summary

In conclusion, our research has implications for learning theory. The findings suggest that tactics that induce trainees to be mindful and active participants in learning, such as seductive details, are beneficial for transfer of procedural knowledge. This research also extends learning theory in that what is beneficial for recognition of declarative knowledge is not necessarily beneficial for transfer. Although we found no differences in recognition as a function of seductive details, the findings suggest that seductive details are beneficial for transfer. These findings need to be replicated across different samples and settings, but they imply that trainers should seek to organize information in such a way that interesting, tangential nuggets of information are included as well as core material. We do not advocate that trainers should include irrelevant information, but that small chunks of interesting, irrelevant information can arouse and maintain trainees' mindfulness.

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